CALIFORNIA DIVISION OF MINES AND GEOLOGY

FAULT EVALUATION REPORT FER-120

April 7, 1981

1. Name of fault.

San Andreas fault, northern San Mateo County area.

2. Location of fault.

San Francisco South and Montara Mountain 7.5-minute quadrangles.

3. Reason for evaluation.

Part of a ten-year program to evaluate and zone active faults in California (see Hart, 1980).

4. References.

Bonilla, M.G., 1971, Preliminary map of the San Francisco South quadrangle and part of the Hunters Point quadrangle, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-311.

Brabb, E.E., and E.H. Pampeyan, 1972, Preliminary geologic map of San Mateo County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-328.

Brown, R.D., 1972, Active faults, probable active faults, and associated fracture zones, San Mateo County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-355.

Burkland and Associates, 1975, Geologic and seismic hazards investigation, Lots 40 through 50 of Block 8, Westborough-West Park Unit 2, South San Francisco, California: Unpublished consulting report filed with the City of South San Francisco (AP# 179).

California Division of Mines and Geology, 1974a, Official map of Special Studies Zones, Montara Mountain quadrangle.

_____, 1974b, Official map of Special Studies Zones, San Francisco South quadrangle.

Gribaldo, Jacobs, Jones and Associates, 1964, Revised report to Westborough Homes, South San Francisco, California, of soil investigation for Westborough, South San Francisco, California;and 1969 revisions:

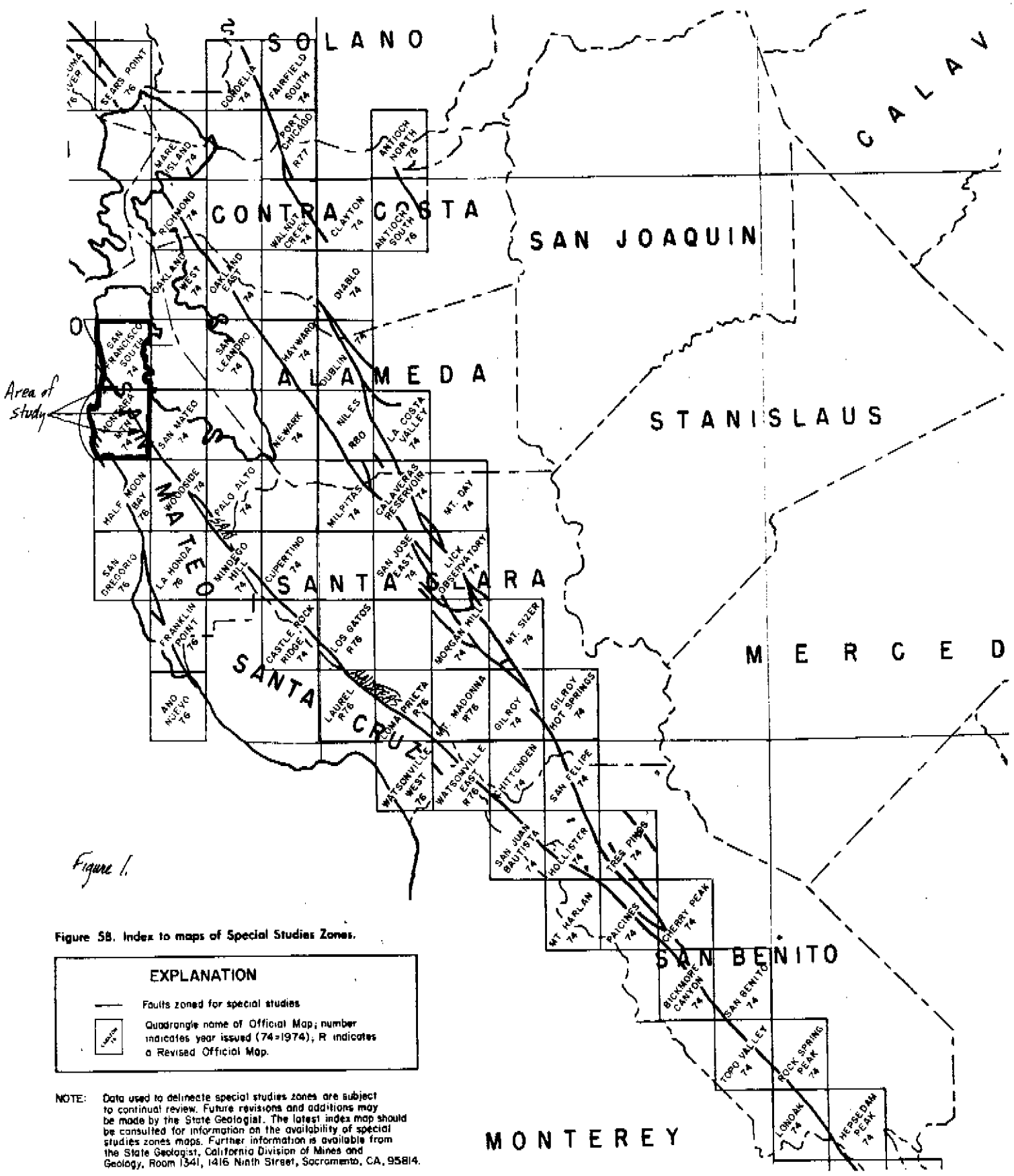

Figure 58. Index to maps of Special Studies Zones.

NOTE: Data used to delineate special studies zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of special studies zones maps. Further information is available from the State Geologist, California Division of Mines and Geology, Room 1341, 1416 Ninth Street, Sacramento, CA, 95814.

Scale 1:1,000,000
1 inch equals approximately 16 miles

Unpublished consulting report filed with the City of South San Francisco (AP# 280).

Hallenbeck-McKay & Associates, 1976, Alquist-Priolo geologic hazards study, Parcel E - Gateway Drive and Hickey Boulevard, Pacifica, California: Unpublished consulting report filed with the City of Pacifica (AP# 279).

Hart, E.W., 1980, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42.

Jones, William, F., Inc., 1979, A geologic and soil investigation for Goodyear Tire store, Daly City, California: Unpublished consulting report filed with the City of Daly City (AP# 951).

Lawson, A.C., and others, 1908, The California earthquake of April 18, 1906. Report of the State Earthquake Investigation Commission: Carnegie Institution of Washington.

Leighton and Associates, 1978, Geologic fault investigation, Haggarty property, Carter Avenue, South San Francisco, California: Unpublished consulting report filed with the City of South San Francisco (AP# 1200).

Pampeyan, E.H., 1975, Geologic map of the San Andreas fault zone in San Andreas Lake, San Mateo County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF -652.

_____, 1979, Preliminary map showing recency of faulting in coastal north-central California: U.S. Geological Survey Miscellaneous Field Studies Map MF -1070.

Purcell, Rhoades & Associates, 1977, Geologic and soil investigation, proposed 4-lot subdivision, intersection of Westborough Boulevard and Fleetwood Drive, San Bruno, California: Unpublished consulting report filed with the City of San Bruno (AP# 555).

Schlocker, J., E.H. Pampeyan, and M.G. Bonilla, 1965, Approximate trace of the main surface rupture in the San Andreas fault zone between Pacifica and the vicinity of Saratoga, California, formed during the earthquake of April 18, 1906: U.S. Geological Survey Open-File Map.

Terrasearch, 1977, Soil and geologic investigation on Skyline Village Condominiums, Westborough-West Park, Block 3, Unit 1, So. San Francisco, California: Unpublished consulting report filed with the City of South San Francisco (AP# 582).

Terratech, 1976, Geological/geotechnical investigation, community center building, San Bruno, California: Unpublished consulting report filed with the City of San Bruno (C# 81).

Woodward-Clyde Consultants, 1976, Alquist-Priolo Special Studies Zone report, Liebman property, San Bruno, California: Unpublished consulting report filed with the City of San Bruno (AP# 230).

Woodward-Clyde Consultants, 1977, Alquist-Priolo Special Studies Zone report, Fairmont Shopping Center additions, Pacifica, California; Unpublished consulting report filed with the City of Pacifica (AP# 519).

Woodward-Lundgren & Associates, 1975, Geologic investigation, proposed addition, King Plaza shopping center, Daly City, California: Unpublished consulting report filed with the City of Daly City (AP# 36).

Aerial photographs used:

Fairchild, 1941, Black and white aerial photos, flight C-6660, numbers 16 to 21, 29 to 33, and 64 to 67, approximate scale 1:15,000.

5. Summary of available information.

The San Andreas fault is a right-lateral, strike-slip fault along which surface rupture occurred in 1906 (Lawson, and others, 1908). Named in the Special Studies Zones Act (see Hart, 1980), the San Andreas was zoned along its entire length in 1974. In the area studied in this FER, two maps were issued (California Division of Mines and Geology, 1974a; 1974b). In this original zoning effort, the zoning criteria differed significantly in that Quaternary faults were zoned unless there was evidence that no activity had occurred along a given fault during the Holocene. Also, the faults depicted on the original map were compiled solely from the existing literature, without field checking or additional air photo interpretation. Thus, the existing SSZ maps may well show faults which either do not exist or are not thought to be active (Holocene).

The San Andreas fault traces depicted on the original SSZ maps were compiled by C.F. Armstrong from Schlocker, et al (1965), Lawson, and others (1908), Brown (1971), Brabb and Pampeyan (1972), and Bonilla (1971).

While conducting this evaluation, I determined that some of the faults shown on the SSZ maps were misplotted in places, but were generally within two hundred feet of the location shown on the original references.

Lawson, and others (1908) described the 1906 rupture zone as being nearly continuous and linear on the peninsula. They noted that landslides near the coast had moved during the earthquake and had obscured the fault trace. Their text includes some fairly detailed descriptions of the fault trace in some locations, and large-scale maps document the location and sense of displacement. The text also indicates displacement occurred along two parallel faults in some places. Except in these specific locations (many of which are noted on Figure 3A and 3B), they only depict the fault as a single trace on a small-scale map.

Brown (1971) also showed the fault on a small-scale (1:62,500) map. The base map he used had much of the topographic detail omitted, making accurate location of the traces he depicts very difficult. He shows more than one active trace along much of the zone in the San Francisco South quadrangle,. However, except for the 1906 trace, the faults he shows do not match those depicted on the maps of Brabb and Pampeyan (1972, 1:62,500 scale) and Bonilla (1971, 1:24,000 scale).

The Schlocker, et al (1965) reference depicts the approximate trace of the 1906 rupture. This map lacks a text; thus it is not known whether they interpreted aerial photographs, performed any field surveys, or simply compiled the trace from Lawson, et al. The Schlocker, et al., map consists of a 1:48,000 scale map (the base is reduced from 1:24,000 scale maps) on which the approximate 1906 break is delineated as a solid line. No secondary faults are shown on their map.

The maps by Brabb and Pampeyan (1972) and Bonilla (1971) are true geologic maps. Essentially all faults that were depicted as possibly cutting the Merced Formation (Plio-Pleistocene) or the Colma Formation (Late Pleistocene), as well as those traces near the 1906 rupture, were plotted on the SSZ maps of 1974.

Subsequent to the publication of the 1974 SSZ maps, Pampeyan (1979, 1:250,000 scale) published a map depicting the relative ages of faulting in the San Francisco Bay area. This map depicts several secondary faults, sub-parallel to the San Andreas, as being Holocene in age. He bases this Holocene designation on topographic features that exist along these faults. Another map by Pampeyan (1975) was also released; however, this map (1:6,000 scale) is primarily a geologic map, and although the San Andreas is delineated, no reference was made as to how the trace was mapped through the Franciscan melange terrain.

Several consulting reports have been filed with the State Geologist documenting the results of site-specific fault investigations. These results are summarized in Table 1. None of the reports filed to date have presented conclusive evidence of the existance of an active fault based on original subsurface work. In most cases, those faults identified have been presumed to be active based on the literature or air photo interpretation. Many of the sites investigated had been highly modified by grading prior to the time the investigations were conducted.

6. Air photo interpretation; field investigation.

The results of my air photo interpretation are presented on Figures 3A and 3B. Fairchild (1941) aerial photographs, obtained from the Whittier

Table 1. Summary of results of site-specific investigations by consulting geologists.

File #	Consultant	Trenching	Other Methods*	Active Fault Found	Comments
AP# 36	Woodward-Lundgren Assoc	Yes	A, L, R	No	
AP# 179	Burkland & Assoc	Yes	A, L, R		Secondary faults found and setbacks established.
AP# 230	Woodward-Clyde Cons	No	A, L, R	No	
AP# 279	Hallenbeck-McKay & Assoc	No	A, B, R		Site extensively graded. Secondary faults identified & setbacks established.
AP# 280	Gribaldo, Jacobs, Jones & Assoc	No	L, B	Yes	1906 trace reportedly crosses site.
AP# 519	Woodward-Clyde Cons		A, L, R, B	No	
AP# 555	Purcell, Rhoades, & Assoc	Yes	A, L, B, R	No	Logs indicate trenches were entirely within fill and did not reach bedrock.
AP# 582	Terrasearch, Inc	No	L, SR		Fault found by SR treated as active.
AP# 951	William F. Jones, Inc	Yes	A, L, R	No	Trench in Merced.
AP# 1200	Leighton & Assoc	No	A, L, R	Yes	Two active faults.
C# 81	Terratech, Inc	Yes	L, M, B, A	No	

A = Air photo interpretation
B = Bore hole correlation
L = Literature review
R = Site reconnaissance
SR = Seismic refraction
M = Magnetometer survey

FEB 120

collection, were interpreted and the data plotted. In most places, the San Andreas appears to consist of a fairly narrow, single, active trace, marked by sag ponds, linear troughs, deflected drainages, and other topographic features indicative of Holocene fault movement. These features closely agree with the traces shown by Schlocker, et al (1965) and Lawson, and others (1908). As Lawson, et al, note, the fault is obscured by landslide deposits near the seashore.

The photos also show several sag ponds which lies east of the main trace in the Pacifica - Daly City area. In almost all cases, however, no well-defined fault-like features could be detected near or trending through these sag areas. Most of these ponds lie in troughs which trend roughly parallel to the San Andreas, which is also roughly parallel to the bedding in the Merced in this area. The bedding attitude is sometimes reflected in the topography as a series of aligned drainages and saddles. Lacking well-defined, fault-like features, it appears that the sag features may have resulted from lateral spreading of the ridge tops. Lawson et al., did report that cracks or fissures were found along the trend of one of these troughs near where the San Andreas crossed Skyline Boulevard (see Figure 3A).

The north end of San Andreas Lake consists of two arms which drown two parallel valleys. The existance of broad linear valleys near the 1906 break suggests that faults exist beneath these valleys. However, no well-defined fault-produced topography was found within either of these valleys, (except that trees recommended for sampling later in this FER) although late Quaternary or even early Holocene faulting could have occurred within them. Tonal lineaments were noted, but these appear to be the result of trenches or pipelines.

In a few places, topographic features were noted which suggest that the fault may not be a single, narrow trace when examined in detail. However, most of these features lie within a relatively narrow zone less than about 400 feet wide. In the valley between San Andreas Lake and Lower Crystal Springs Reservoir, for example, several en echelon features were noted. Lawson, et al (p. 100) describe one location in this area in detail, noting that offset of more than 3 feet occurred along each of two subparallel faults. At present, data on hand are insufficient to pinpoint the exact location of the site they describe.

Several of the faults depicted by Brown (1971) and Bonilla (1971) could not be vertified on the air photos. If these faults exist as shown, they are likely not Holocene in age.

In view of the limited time available, field reconnaissance was not conducted. One casual observation was made of a sag pond near the northern end of San Andreas Lake (see Figure 3B).

7. Conclusions.

The San Andreas fault has been active in historic time, and is, therefore, sufficiently active. Historic accounts of the 1906 earthquake and associated fault rupture are fairly detailed for the time. And, well-defined fault features are visible on old aerial photographs. Some of these features are still preserved on lands of the City of San Francisco watershed. However, extensive modification of the surface has obliterated these fault-produced features in most of the urbanized area.

It appears that several of the secondary faults depicted on the 1974 SSZ maps either do not exist, are not well-defined, or are not Holocene in age.

These include faults depicted by Bonilla (1971), Brabb and Pampeyan (1972), Brown (1972), and Pampeyan (1979). Several sag ponds exist east of the main fault in the Daly City - Pacifica area which are probably the result of lateral spreading of the ridge tops; however, some ground deformation was reported along one of these zones during the 1906 earthquake (site A, on Figure 4B). Whether this deformation was the result of minor tectonic movement or seismically induced ground failure is not known.

Some other features were identified using old air photos. However, most of these features appear to be non-tectonic in origin.

8. Recommendations.

Revision of the existing Special Studies Zones maps (CDMG, 1974a; 1974b) is warranted. The traces shown on the revised maps should be those of Schlocker, et al (1965) and Lawson, and others (1908), supplemented by selected features shown on Figure 3A and 3B believed to be the result of recent faulting. The faults and zones should be approximately as depicted on Figures 4A and 4B.

9. Investigating geologist; date.

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April 7, 1981

TCS/map

Recommendations approved. Smith 4/15/81